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STOCK ASSESSMENT OF ATLANTIC SURFCLAM OF THE ÎLES-DE-LA-MADELEINE IN 2015

S. Brulotte, DFO, Québec Region, 2012.

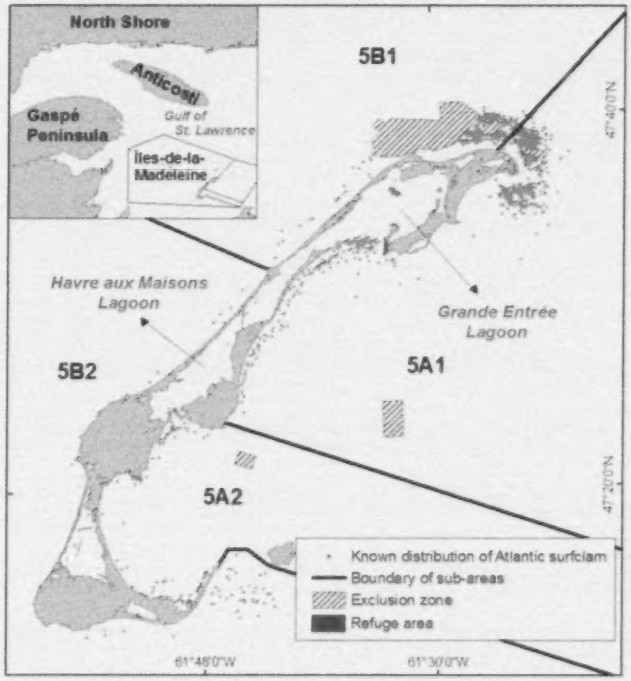

Figure 1. Management sub-areas (5A1, 5A2, 5B1 and 5B2) and known distribution of the Atlantic Surfclam in the Îles-de-la-Madeleine.

Context:

*In Québec, the Atlantic Surfclam (*Spisula solidissima*) fishery is conducted exclusively in the Îles-de-la-Madeleine. Boats harvest the clams with a hydraulic dredge in coastal waters. Divers and shore harvesters also use hand tools to gather them in lagoons or near shore. Hand tools are used in both recreational and commercial fisheries. Magdalen Islanders have been hand digging for clams for a very long time, whereas the dredge fishery started in the late 1990s.*

Atlantic Surfclam stocks are assessed every three years, and the most recent assessment was performed in 2013. The main indicators used to monitor these stocks are landings, fishing effort, catch per unit effort, size structure and the percentage of known beds that have been dredged.

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Canada

SUMMARY

- The Atlantic Surfclam fishery in the Îles-de-la-Madeleine is conducted with hydraulic dredges in sub-areas 5A1 and 5B1 or using hand tools, on foot or while diving, in about 10 shellfish sectors located in lagoons or near coasts.

Hydraulic dredge fishery

- Three beds were delineated in 5A1 and 5B1. The CGE and East beds are located in 5A1 and the North bed straddles sub-areas 5A1 and 5B1. Since 2009, all harvesting has been focused on the North bed, whose known area continues to grow as a result of exploration towards the north. There is no information on recruitment for any of these beds.
- Since 2002, there has been no dredge fishery in sub-area 5A2 and fishing effort is sporadic and low in sub-area 5B2; the clam stock status is therefore unknown in these two sub-areas.
- Since 2012, the total allowable catch (TAC) has been caught in 5A1 and 5B1. Fishing effort is below the reference average in both sub-areas.
- Catches per unit effort (CPUE) calculated for the entire North bed have been high and stable since 2009.
- In the last three years, the average size of landed clams was above the reference average in the North bed.
- Since 2009, between 5.6% and 9.3% of the North bed area has been dredged annually, and the yearly average for the last three years was 7.5%.
- Good yields and size structure stability in recent years are probably attributable to the constant movement of fishing effort to new areas of the North bed. However, the total size of this bed is not yet known. Based on existing information, current landing levels could be maintained.

Hand digging

- Commercial and recreational hand digging by divers and shore harvesters is a very popular, well-developed activity in the Îles-de-la-Madeleine. Commercial hand harvesting data from logbooks are most likely incomplete, and the extent of recreational hand digging is unknown. The estimate of unreported fishing activities can provide a rough idea of the missing landings. For 2013, this estimate is about 84 t for unreported hand harvesting; 2014 and 2015 data are not yet available.
- Known commercial hand digging landings vary with fishing effort. The averages for the last three years are 35 t and 231 days.
- Since 2010, CPUEs for commercial harvesting by divers and shore harvesters have been fairly stable, but both are generally below the reference average.
- Since 2008, the annual average size of clams collected by diving is near the reference average. Clams gathered by shore harvesters are smaller and their average size is smaller than that of clams harvested by other methods. However, clam size has risen since the minimum legal size was increased in 2014.
- Based on this information, hand harvesting could be maintained at the current level. Any measures that will help better document hand digging are desirable.

BACKGROUND

The Atlantic Surfclam, *Spisula solidissima*, is a filter feeding bivalve mollusc that lives along the Atlantic coast of North America, from Gaspé Bay in the Gulf of St. Lawrence to Cape Hatteras, in North Carolina. Surfclam habitat extends from the upper infralittoral zone to a depth of 30 to 60 m depending on the region. The Surfclam lives buried in sediments and prefers mixtures of sand, clay and gravel. It is a sedentary species living in aggregations of more or less importance called "beds".

According to the literature, Atlantic Surfclam reach sexual maturity at four years of age. In the Îles-de-la-Madeleine, shell length (measured in the largest axis of the shells) reaches 76 mm in four or five years and 90 mm in five or six years. The Surfclam can live more than 30 years with a maximum shell length of about 225 mm. The maximum size observed in the Îles-de-la-Madeleine is 176 mm.

The sexes are separate and the Surfclam does not exhibit sexual dimorphism. In the Îles-de-la-Madeleine, the gonads are fully mature by mid-May. Spawning takes place mainly in July and August. The gametes are released into the water, where the ovules are fertilized. The larvae are pelagic. The duration of the larval phase is dependent on water temperature; about 35 days at 14°C. After metamorphosis, juveniles settle to the bottom and begin their benthic life stage.

Generally, recommended conservation measures aim to ensure the sustainability of each bed by maintaining its reproductive potential.

ASSESSMENT

In the Îles-de-la-Madeleine, the Atlantic Surfclam fishery is conducted with a hydraulic dredge in Area 5 or by using hand tools, on foot or while diving in the lagoons or along the coast (Figure 1). From 2002 to 2013, the minimum legal size was 76 mm, but it has been 90 mm since 2014 for every harvesting method. Also, Atlantic Surfclam harvesting is prohibited in shellfish area A-08.4 (refuge area) and exclusion zones, most of which were established in 2011 to protect lobster habitat.

Commercial fishery indicators, i.e. landings (t of live weight), fishing effort (number of days) and CPUE (km/hm for dredging or kg/h for hand digging), are compiled from information taken from logbooks and purchase slips. Size structures and median size are from Surfclam samples measured at landing by the DFO commercial catch sampling program. The georeferenced dredge harvesting positions are based on data from logbooks dating back to 2002 and At-Sea Observer Program data dating back to 2005. CPUEs have been standardized to reflect the dredge harvesting month and fisherman and the shellfish area for hand digging. The reference period may vary between indicators and sub-areas depending on the historical series available. It is generally from 2002 to 2014 for the dredge fishery, except for average size where the reference period is from 2004 to 2014 and for sub-area 5B1 and the North bed where the period is from 2008 to 2014. The reference period for hand digging is from 2005 to 2014.

Hydraulic dredge fishery

Exploratory fisheries were conducted in the Îles-de-la-Madeleine in 1978, 1984 and 1985. No beds detected in the area covered at that time were large enough to support a commercial Atlantic Surfclam fishery. However, some fishermen continued to explore the area and eventually discovered some promising beds. A management plan to manage this fishery was not established until the fall of 2001. It finally became possible to monitor this fishery when logbooks were introduced in 2002.

In Québec, the commercial dredge fishery is restricted to Area 5 of the Îles-de-la-Madeleine. Initially, the fishery was conducted exclusively in the east of the archipelago in an area roughly equivalent to current sub-area 5A1. To encourage fishermen to explore all of Area 5, the area was divided into sub-areas. Since 2011, there are four sub-areas: 5A1, 5A2, 5B1 and 5B2. The boundaries of sub-areas 5A1 and 5B1 were slightly modified in the northern part of the Islands in 2013 (Figure 1). Despite these incentives, sub-area 5A2 has not been harvested since 2002. The exploitation rate in sub-area 5B2 is low, and it is only harvested sporadically. Stock assessments can therefore only be performed in sub-areas 5A1 and 5B1. All the indicators have been recalculated to reflect the new sub-area boundaries.

There are four commercial dredge fishery licences. Harvesting is permitted from the start of April until the end of December. The fishery is closed in July and August in sub-areas 5A1, 5A2 and 5B1 during the Surfclam spawning period. Fishermen are entitled to use only one dredge whose maximum width is 2.13 m, and whose rods must be at least 3.175 cm apart. In 2015, the TAC was 125 t in 5A1, 55 t in 5A2 and 113 t in 5B1. Also, fishing effort was limited to 44 days in 5A1, 36 days in 5B1 and 12 days in 5B2.

From 2002 to 2014, landings were estimated based on the number of baskets multiplied by the estimated weight of one basket, 54 kg/basket from 2002 to 2011 and 66 kg/basket from 2012 to 2014. Since 2015, all clams landed must be weighed at dockside point of landing. The conversion weight had to be increased because over the years the fishermen had been filling their baskets a little more. To ensure CPUEs were comparable throughout the historical series, from 2002 to 2015, the conversion weight was gradually adjusted. This adjustment was based on a detailed analysis of the information gathered from fishermen from 2012 to 2014. The following adjustments were made:

1) from 2002 to 2008, an average weight of 54 kg/basket,
2) from 2009 to 2011, an average weight of 60 kg/basket, and
3) from 2012 to 2014, the conversion weight ranges from 64 to 70 kg/basket depending on the fisherman.

Three beds (CGE, East and North) were delineated in 5A1 and 5B1 based on logbook harvesting positions. The CGE and East beds are located in 5A1 and the North bed straddles sub-areas 5A1 and 5B1 (Figure 2). Since 2009, the dredge fishery is conducted mainly in the North bed. The known area of this bed is increasing from year to year as exploration continues northward.

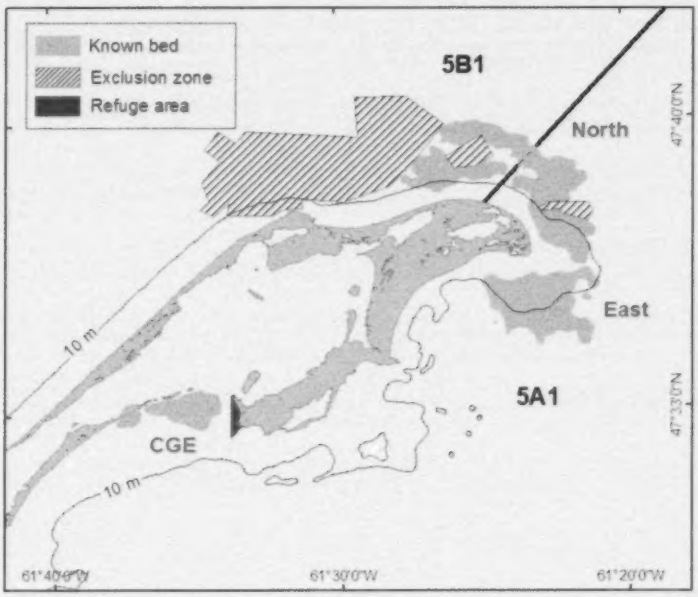

Figure 2. Location of known Atlantic Surfclam beds, CGE, East and North, exploited by the commercial dredge fishery in sub-areas 5A1 and 5B1 of the Îles-de-la-Madeleine.

Sub-area 5A1

Since 2010, the dredge fishery in sub-area 5A1 is conducted almost exclusively in the northern section (Figure 3). New sections of the bed have been exploited and consequently the known area of the bed is gradually increasing.

Atlantic Surfclam landings in sub-area 5A1 have ranged from 102 to 132 t throughout the years (Figure 4 and Table 1). From 2007 to 2012, the TAC was caught or slightly exceeded. However, when the sub-area boundaries were redefined in 2013, part of the landings caught in 5A1 were transferred to 5B1. From 2013 to 2015, the TACs were caught and even exceeded. In 2015, 126 t were landed and the average of the three previous years was 129 t.

Fishing effort in fishing days was higher (64-65 days) at the beginning of harvesting (Table 1). Since 2008, the maximum fishing effort has been 43 days. In 2015, fishing effort was 26 days, 38% below average for the reference period.

Since 2010, standardized CPUEs have remained above the reference average (Figure 5 and Table 1). 2012 and 2013 values were higher than historical values in sub-area 5A1. In 2015, the CPUE was 281 kg/hm, 46% higher than the reference average. The average from 2013 to 2015 was 296 kg/hm. CPUEs remain at high levels, which is probably attributable to the exploitation of new harvesting sites.

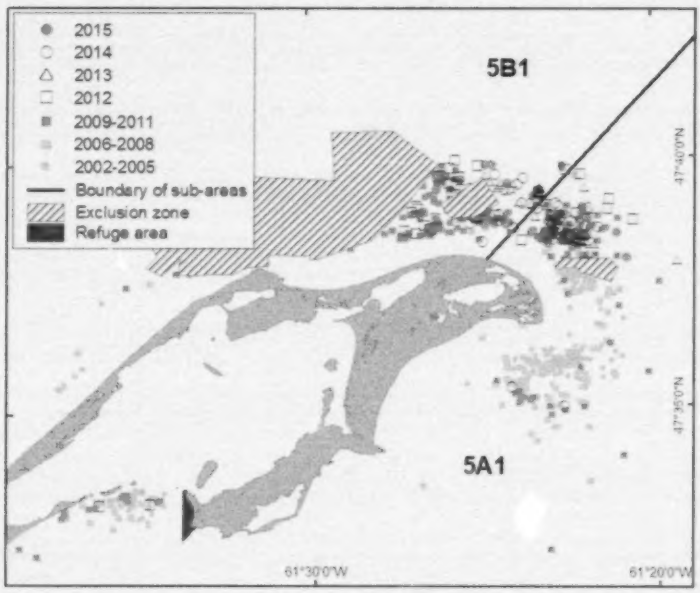

Figure 3. Location of the commercial Atlantic Surfclam dredge fishery from 2002 to 2015 in sub-areas 5A1 and 5B1 of the Îles-de-la-Madeleine.

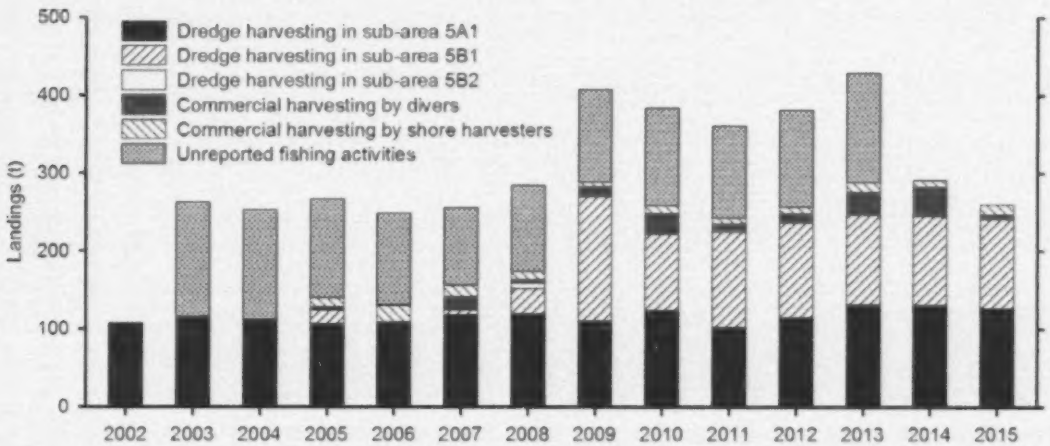

Figure 4. Annual landings (t) of Atlantic Surfclam by sub-area and harvesting method in the Îles-de-la-Madeleine.

The increase in minimum legal size to 90 mm in 2013 had little effect on average sizes, because landed clams had generally been over 90 mm since 2008. The average size of landed clams in the five previous years was greater than 126 mm (Table 1). The primary trend in recent years is upward with an average size of 133 mm in 2015.

Table 1. Landings (t), fishing effort (number of days), average catch per unit effort (kg/hm), average size (mm) at landing and dredged area of known beds (%) from 2002 to 2015 in sub-areas 5A1 and 5B1 and the North bed exploited by the commercial Atlantic Surfclam dredge fishery in the Îles-de-la-Madeleine.

Year	5A1				5B1				North Bed	
	Landings	Effort	CPUE	Size	Landings	Effort	CPUE	Size	CPUE	Size
2002	108	65	132							
2003	115	64	119							
2004	112	64	108	110						
2005	107	31	203	110						
2006	108	55	135	114						
2007	119	62	113	124						
2008	120	42	136	121	32	13	126	120	193	
2009	110	43	165	124	160	53	221	121	220	121
2010	124	34	235	124	97	28	238	120	258	123
2011	102	25	233	127	123	36	246	127	227	127
2012	114	17	325	128	122	23	279	133	296	130
2013	132	21	356	126	115	20	249	136	278	131
2014	130	24	249	133	115	18	313	131	256	132
2015	126	26	281	133	115	19	296	134	259	134
Ref. [1]	115	42	193	122	109	27	239	127	247	127
Diff. [2]	10%	-38%	46%	9%	5%	-30%	24%	6%	5%	5%
Avg. [3]	129	24	296	131	115	19	286	134	264	132

[1] *2002-2014 or 2008-2014 reference average.*
[2] *Difference between the 2015 value and the reference average.*
[3] *Average of the three previous years (2013-2015).*

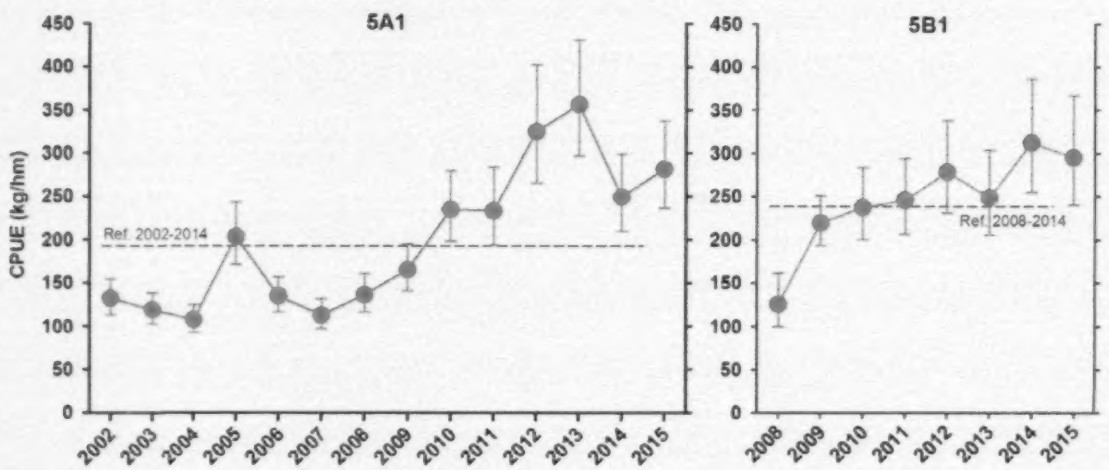

Figure 5. Average annual catch per unit effort (CPUE ± 95% confidence interval) and reference average (ref.) for sub-areas 5A1 and 5B1 exploited by the commercial Atlantic Surfclam dredge fishery in the Îles-de-la-Madeleine.

The estimated total area of known beds in sub-area 5A1 is 24 km^2. The area of the CGE and East beds has not changed since 2008, whereas the area of the North bed continues to grow (Table 2). The estimated area of the North bed from 2002 to 2015 takes into account the change in the boundaries of sub-areas 5A1 and 5B1.

Table 2. Estimated area (km^2) of the various known Atlantic Surfclam beds in the Îles-de-la-Madeleine.

Year	5A1-CGE	5A1-East	5A1-North	5B1-North	North
2002-2009	4.13	10.72	6.47	3.49	9.96
2002-2012	4.13	10.72	7.97	5.57	13.54
2002-2015	4.13	10.72	9.21	8.03	17.24

The estimated dredged area per bed is based on fishing effort (hm) and the average 1.52 km/h (0.82 knot) dredging speed. The percentages of the beds dredged are all calculated based on the greatest area, i.e., the area from 2002 to 2015 (Table 3). High percentages, above 8%, were observed from 2002 to 2008 in the CGE and East beds, but these beds have hardly ever been visited since 2010. The part of the North bed included in sub-area 5A1 has been exploited more intensively since 2005. The dredged percentage of this bed reached 8.6% in 2015, 78% above the reference average. The average pe.centage of the dredged area of the North bed (5A1) in the last three years was 7.4%.

Table 3. Estimated percentage (%) of bed areas dredged from 2002 to 2015 in sub-areas 5A1 and 5B1 based on the commercial Atlantic Surfclam dredge fishery in the Îles-de-la-Madeleine.

Year	5A1-CGE	5A1-East	5A1-North	5B1-North	Total-North
2002	3.2	10.7	0.2		
2003	12.3	9.9	0.9		
2004	10.8	10.6	1.7		
2005	1.2	3.4	5.5		
2006	8.7	0.8	9.7		
2007	1.8	10.3	6.5		
2008	2.8	10.4	2.4	3.5	2.9
2009	6.1	6.5	3.7	15.8	9.3
2010	0.9	0.3	8.3	7.3	7.8
2011	1.0	0	5.6	9.9	7.6
2012	0.8	0	4.6	6.7	5.6
2013	0	0	5.8	7.7	6.7
2014	0	0.4	7.7	7.0	7.4
2015	0	0	8.6	8.0	8.3
Reference average [1]	3.8	4.9	4.8	8.3	6.8
Difference [2]			78%	-3%	23%
2013-2015 Average	0	0.1	7.4	7.6	7.5

[1] *2002-2014 period for the CGE, East and North beds (5A1) and from 2008-2014 for the North bed (5B1 and total).*
[2] *Difference between the 2015 value and the reference level.*

Sub-area 5B1

Prior to 2008, harvesting in sub-area 5B1 was sporadic. The North bed in sub-area 5B1 was discovered in 2008 (Figures 3 and 4).

The TAC has been reached or slightly exceeded since 2010. However, as a result of the new sub-area boundary lines, part of the landings caught in 5A1 was transferred to 5B1. Landings from 5B1 ranged from 97 to 123 t from 2010 to 2015 (Figure 4 and Table 1). The 2015 landings and the average for the last three years were 115 t. The high fishing effort in 2009 and 2011 was associated with large landings. However, since 2013, fishing effort has ranged from 18 to 20 days, values below reference average (Table 1).

CPUEs increased to about 300 kg/hm in 2014 and 2015, which was above reference average (Figure 5 and Table 1). The average CPUE in the last three years was 286 kg/hm.

Since 2008, the average size of landed clams from sub-area 5B1 was similar to that of 5A1 (Table 1). The increase in minimum legal size to 90 mm in 2013 had little effect on average sizes, because landed clams had generally been over 90 mm. The average size of landed clams in the three previous years was greater than 134 mm.

The area of the North bed in sub-area 5B1 was estimated at 8 km^2 in 2015 (Table 2 and Figure 2). This area has gradually been increasing since 2008 as a result of the constant exploration for new fishing sites in this area. A very high percentage (15.8%) of the bed area was dredged in 2009 (Table 3). However, since then, this proportion has ranged from 6.7% to 9.9%. The average proportion in the last three years was 7.6%.

North bed, sub-areas 5A1 and 5B1

Because virtually all the exploitation in recent years occurred in the North bed, which straddles sub-areas 5A1 and 5B1 (Figure 2), the various monitoring indicators were recalculated to reflect the history and current status of this bed (Table 1 and Figure 6). Since 2009, the standardized CPUE has been hovering around the 247 kg/hm reference level. The average 2013-2015 CPUE was 264 kg/hm. These values are about twice as high as those observed from 2002 to 2008 in the CGE and East beds in sub-area 5A1 (Table 1).

Since 2010, the average size of landed clams from the North bed has been greater than or equal to 127 mm, which is above the reference average (Table 1). The average size in the last three years was 132 mm.

In 2015, the average size of the North bed was estimated at a little over 17 km^2 (Table 2). Since 2009, the annual percentage of the dredged area has ranged from 5.6% to 9.3% (Table 3). In 2015, 8.3% of the bed was dredged and the 2013-2015 average was 7.5%.

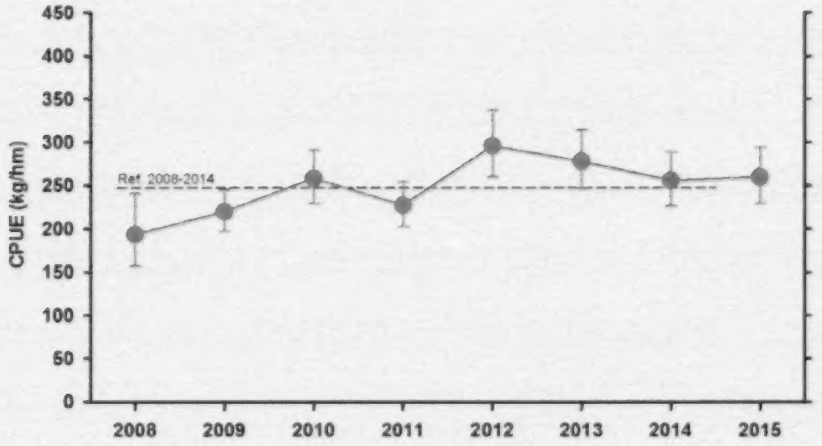

Figure 6. Average annual catch per unit effort (CPUE ± 95% confidence interval) and reference average (ref.) for the entire North bed exploited by the commercial Atlantic Surfclam dredge fishery in the Îles-de-la-Madeleine.

Hand digging

In 2003, new provisions amending the 1985 Atlantic Fisheries Regulations provided a better framework for recreational harvesting of several molluscs, including the Atlantic Surfclam, by specifying authorized gear, minimum catch size and daily limits. An initial management plan was established in 2005 to regulate hand digging (hand tools) of Atlantic Surfclam in the Îles-de-la-Madeleine. Since then, all shore harvesters and divers wishing to sell their catches or gather

more than 300 clams per day must obtain a commercial license. From 121 to 155 licenses have been issued annually since 2005. However, there are between 19 and 44 active harvesters every year. Commercial and recreational hand harvesters must comply with the following regulations:

1) The fishing season is open for nearly 12 months, from mid-January to the end of December;
2) The minimum legal size is 90 mm; and
3) Commercial harvesters must keep a logbook.

There is a long history of harvesting Atlantic Surfclam by hand along the shores of the Îles-de-la-Madeleine and in its lagoons. Hand harvesting is very popular during the summer. Clams are hand harvested in about 10 shellfish areas, but more intensively in areas A-09.5 (mainly islets B and C) and A-09.1, located in the Grande Entrée lagoon, along Dune-du-Sud (A-12.1), at Havre aux Maisons channel (A-16.1.2), Camping Gros-Cap (A-16.2.1.1) and along Plage de La Martinique (A-17.1) and Sandy Hook dune (A-17.4) in Plaisance Bay (Figure 7). According to an annual census conducted by volunteers, and based on information recorded in logbooks, on warm summer days, there may be more than 50 harvesters on one bed.

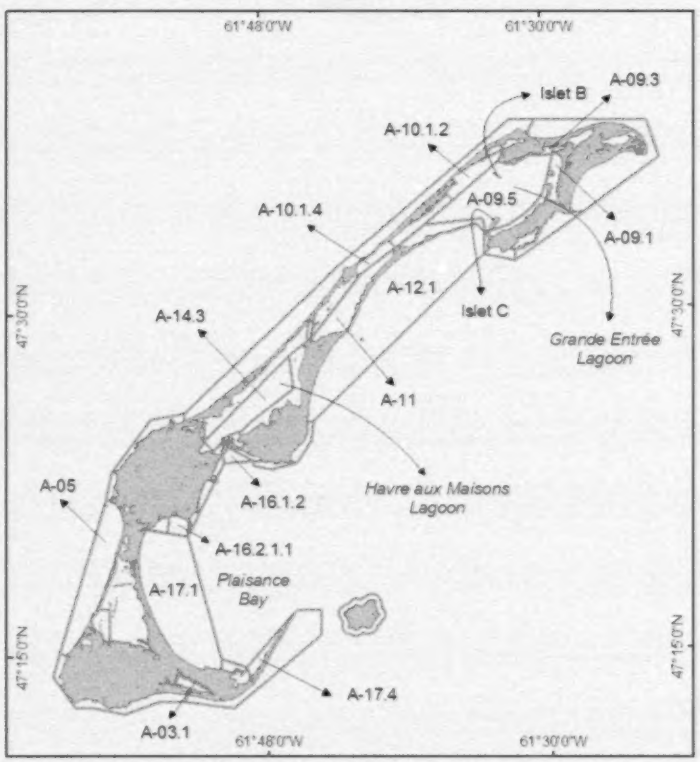

Figure 7. The location of the main shellfish areas and the two islets (B and C) in the Grande Entrée lagoon where the Atlantic Surfclam is hand harvested in the Îles-de-la-Madeleine.

Despite its popularity, little information is available on hand digging by divers or shore harvesters. According to a survey conducted from 2005 to 2010, between 30% and 60% of active commercial harvesters do not fill in their logbooks, and there is no information on harvests by recreational harvesters. The estimate of unreported fishing activities can provide a

rough idea of the missing landings. From 2002 to 2013, this estimate has ranged from 99 t to 147 t (Figure 4). In 2013, the estimate was 140 t for all unreported Atlantic Surfclam landings in the Islands. The 2014 and 2015 values are not yet available. Unreported commercial and recreational hand digging landings are believed to be about 60% of the estimated total. In 2013, unreported hand digging activities therefore represented about 84 t of landings.

Because these are partial fishing effort data, it is difficult to accurately assess the status of each bed that has been hand harvested. Commercial harvest indicators have therefore been calculated for all harvested shellfish areas using information in available logbooks. Since the harvest is mainly conducted in shellfish area A-12.1 (by divers) and A-09.5 (by shore harvesters), there is sufficient information to calculate the CPUEs for these two shellfish areas.

Clams harvested by divers

Commercial landings of clams hand harvested by divers vary greatly from year to year depending on the divers' efforts (Table 4 and Figure 4). The 2013, 2014 and 2015 landings were respectively 29.1 t, 36.5 t and 6.0 t, a 23.8 t average for the three years. The average effort for these years was 107 days. Landings and fishing effort were low in 2015, largely due to unfavourable weather conditions. Landings in recent years were primarily from shellfish area A-12.1 and, to a lesser extent from areas A-09.5 and A-09.1.

From 2010 to 2014, standardized CPUEs for commercial harvesting by divers remained around the 2005-2014 reference average of 53.5 kg/h (Table 4 and Figure 8). The 2015 CPUE of 36.4 kg/h was below this reference average and is the lowest value in the series. The average CPUE in the last three years was 46.7 kg/h.

Table 4. Landings (t), fishing effort (number of days), average catch per unit effort (kg/h), and average size (mm) at landing from 2005 to 2015 of Atlantic Surfclam commercially hand harvested by divers and shore harvesters in the Îles-de-la-Madeleine.

Year	Divers					Shore Harvesters					Hand Digging	
	Landings	Effort	CPUE Total	CPUE A-12.1	Size	Landings	Effort	CPUE Total	CPUE A-09.5	Size	Landings	Effort
2005	3.4	17	43.1	53.4	113	11.3	92	26.2	39.1	89	14.7	109
2006	1.5	11	53.6		128	21.7	189	27.8	33.6	94	23.2	200
2007	17.1	66	66.4	61.3	129	15.0	156	25.5	28.7	109	32.1	222
2008	5.4	21	62.8	91.6	136	10.2	92	28.4	35.4	102	15.6	113
2009	12.1	40	69.0	67.4	132	5.9	65	24.5	30.4	97	18.0	105
2010	26.9	138	46.6	56.6	133	10.8	142	17.8	17.9	100	37.7	280
2011	7.6	37	44.8	41.1	130	8.1	83	20.3	20.7	105	15.7	120
2012	12.4	61	44.9	54.0	131	8.2	98	17.0	17.5	104	20.6	159
2013	29.1	128	55.8	61.5	129	13.0	131	22.7	21.6	100	42.1	259
2014	36.5	148	47.9	62.9	144	8.5	103	19.5	20.0	108	45.0	251
2015	6.0	44	36.4	49.4		12.2	138	21.3	20.4	115	18.2	182
Ref. [1]	15.2	67	53.5	61.1	131	11.3	115	23.0	26.5	101	26.5	182
Diff. [2]	-60%	-34%	-32%	-19%		9%	20%	-7%	-23%	14%	-31%	0%
Avg. [3]	23.8	107	46.7	58.0	136	11.3	124	21.1	20.7	108	35.1	231

[1] *Reference average 2005-2014.*
[2] *Difference between the 2015 value and the reference average.*
[3] *Average of the three previous years (2013-2015).*

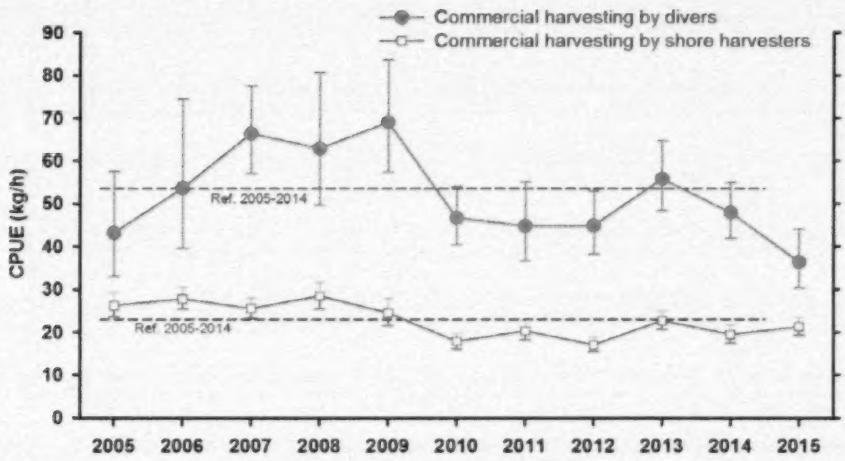

Figure 8. Average annual catch per unit effort (CPUE ± 95% confidence interval) for the Atlantic Surfclam commercially hand harvested by divers and shore harvesters (with their respective reference average) in the Îles-de-la-Madeleine.

The CPUE trends in shellfish area A-12.1 are the same as in all other areas. The lowest values in area A-12.1 were observed in 2011 at 41.1 kg/h and 49.4 kg/h in 2015 (Table 4).

Since 2007, the average size of clams from landings harvested by divers has been at least equal to 129 mm and has remained around reference average (Table 4). There was no clam sampling campaign in 2015, and the average size calculated in 2014 was very large (144 mm) compared to previous years.

Shore harvesting

Since 2005, landings of clams gathered commercially by shore harvesters were between 6 t and 22 t per year (Table 4 and Figure 4). The average for the three previous years was 11.3 t. Variations in landings were mainly attributable to the number of days of harvesting (number of logbooks received). The average fishing effort from 2013 to 2015 was 124 days. Landings in recent years were primarily from shellfish area A-09.5 and, to a lesser extent from areas A-12.1, A-16.2.1.1, A-17.1 and A-17.4.

Prior to 2010, commercial CPUEs for clams hand gathered by shore harvesters were similar to or greater than the 23 kg/h reference level (Table 4 and Figure 8). Since 2010, CPUEs have been stable but below reference average, except in 2013. The 2013-2015 average CPUE was 21.1 kg/h.

CPUEs from shellfish area A-09.5 followed similar trends with values greater than 28 kg/h from 2005 to 2009 and less than 22 kg/h from 2010 to 2015 (Table 4). The CPUE average for the last three years for this harvesting area was 20.7 kg/h.

The average landed clam size was smallest in this fishery (Table 4). The reference average (2005-2014) is 100 mm. However, the increase in minimum legal size to 90 mm has had a perceptible effect on average size in the last two years, which was 108 mm in 2014 and 115 mm in 2015.

Sources of uncertainty

The lack of information on hand harvesting, which is mainly recreational, could also affect findings regarding this fishery. Moreover, as the territory is shared by dredge harvesting and hand digging and between commercial and recreational harvesters, it makes it difficult to obtain a comprehensive portrait of the situation.

Because there is no independent indicator from research surveys for beds harvested by dredging or hand digging, scientific advice on Atlantic Surfclam stock status is entirely dependent on the quality of data from the commercial fishery.

There was no dockside monitoring for this species (dredge) until 2014. Commercial landings were estimated based on the number of baskets landed and the average weight of one basket. This situation creates uncertainty regarding official landing figures and commercial yields (CPUE) used to assess the status of the resource from 2009 to 2014.

CONCLUSIONS AND ADVICE

Hydraulic dredge fishery

The hydraulic dredge fishery is still developing in the Îles-de-la-Madeleine and is partially conducted in new sections of Surfclam beds from year to year. Virtually all harvesting operations were performed in the North bed. Good yields and size structure stability are attributable to the constant movement of fishing effort. The total extent of the North bed is not yet known. The current exploitation pattern will make it difficult to assess the status of the population based on commercial indicators until the bed has been completely delineated, and the entire bed has been exploited at least once.

For the time being, fishing indicators (CPUE and size structure) are stable in the North bed. Between 5.6% to 9.3% of this bed has been dredged since 2009, values slightly lower than those observed in the CGE and East beds from 2002 to 2008. Based on all available information, current landing levels could be maintained.

It is important to specify that yields are much lower in the CGE and East beds. In the event that exploration of the North bed is terminated, we will have to remain vigilant and ensure that the fishing effort to achieve the TAC is not too high. Despite restricted fishing effort in sub-areas 5A1, 5B1 and 5B2, fishing effort will need to be monitored on an annual basis in the coming years.

Hand digging

Although commercial and recreational hand digging is a large-scale activity in the Îles-de-la-Madeleine, there is very little information available on hand harvesting of the Atlantic Surfclam. The only data come from commercial fishery logbooks. Any measures that will help better document hand digging are desirable to enable a more comprehensive assessment of the status of this part of the population.

Since 2010, CPUEs for commercial hand harvesting by divers and shore harvesters have been fairly stable, but both are generally below their reference average. The average size of clams landed by divers remains large, and the average size of clams gathered by shore harvesters has improved since the minimum legal size was increased. Based on this information, hand harvesting could be maintained at the current level.

OTHER CONSIDERATIONS

The recommended conservation measures are designed to ensure the sustainability of each bed and allow them to renew themselves. A significant decrease in the density of each bed could compromise the fertilization of ovules and the production of larvae in the Îles-de-la-Madeleine.

We do not know the source and level of recruitment in the various beds. As long as we do not have this information, any initiatives aimed at maintaining or even increasing the reproductive potential of each shellfish area by leaving more adults on the bottom or creating refuge areas will have a positive impact on resource conservation. Increasing the minimum legal size to 90 mm was beneficial mainly in shellfish areas gathered by shore harvesters. Also, halting the dredge fishery when the clams spawn and juveniles are deposited on the bottom can only help protect the beds' reproductive potential and clam recruitment.

Similarly, knowledge of the size at which the Atlantic Surfclam reaches sexual maturity in the Îles-de-la-Madeleine and the abundance and demographic structure of clams in refuge area A-08.4 would be an asset in managing this resource.

We should keep in mind that the surveys completed in 2012 of the beds that can be hand harvested, islets B and C in A-09.5 and A-16.2.1.1, show that nearly all these beds can be reached on foot. Also, the density figures obtained in 2012 in two of these beds were below those reported in 2007, which suggest they are under high fishing pressure from shore harvesters.

SOURCES OF INFORMATION

This Science Advisory Report is from the meeting held on February 23, 2016 on Stock assessment of Atlantic Surfclam of the Magdalen Islands. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada Science Advisory Schedule as they become available.

Brulotte, S. 2013. Assessment of Atlantic surfclam, *Spisula solidissima*, in the coastal waters of the Îles-de-la-Madeleine, Québec – methodology and results. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/082. v + 58 p.

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